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First record of Chilapata rain-pool frog *Minervarya chilapata* Ohler, Deuti, Grosjean, Paul, Ayyaswamy, Ahmed & Dutta, 2009 (Anura, Dicroglossidae) from Nepal

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Abstract

Chilapata rain-pool frog (*Minervarya chilapata*) was described in 2009 from the Chilapata Reserve Forest of West Bengal, India. Here, we report the occurrence of *M. chilapata* for the first time from Morang district, Nepal, based on acoustic and morphological characters such as the presence of a distinct white line in the upper lip, small size (snout-vent length 18 to 26 mm), pointed snout and presence of dorso-lateral black patch. The nearest record of Chilapata rain-pool frog in Nepal from Pathari-Kanepokhari forest, Morang district, Nepal is ca.182 km west of its type locality Chilapata Reserve Forest, Jalpaiguri district, West Bengal, India. We also report the occurrence of *M. chilapata* from Barandabhar Biological Corridor, Chitwan National Park, Nepal based on a photographic record. The International Union for Conservation of Nature (IUCN) has listed the species as Data Deficient. Therefore, this record from Nepal will add new presence data for future status assessment for the species.

Key Words

amphibians, biodiversity hotspot, biological corridor, Chitwan National Park, eastern Nepal, non-protected forest

The frog genus *Minervarya* Dubois, Ohler, and Biju 2001 has 37 species globally (Frost 2022) with distribution across Asian countries, including Bangladesh, Bhutan, China, India, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand (Garg and Biju 2021; Frost 2022). Four of these species, namely *M. nepalensis*, *M. pierrei*, *M. syhadrensis* and *M. teraiensis* are known in Nepal (Khatiwada et al. 2021). The genus is much discussed among taxonomists since the morphological characteristics of its members are often confused with those of frogs in the genus *Fejervarya* Bolkay, 1915 and *Sphaerotheca* Günther, 1859 (Dinesh et al. 2015; Garg and Biju 2017, 2021; Sanchez et al. 2018). The taxonomy of Nepal's *Minervarya* species has recently been revised and updated including a new record of *Minervarya orissaensis* in Nepal (Khatiwada et al. 2021). However, due to deep genetic divergence for the mitochondrial 16S gene "*M. orissaensis*" has been formally placed in the genus *Fejarvarya* (see Garg and Biju 2021; Frost 2022). Although Nepalese amphibians and associated habitats are generally poorly studied (Gautam et al. 2020), recent works have described four new species from Nepal (see Khatiwada et al. 2015, 2017, 2019, 2020a) and four new records for Nepal (Khatiwada et al. 2017; Bhattarai et al. 2020; Khatiwada

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et al. 2021) suggesting that many amphibian species are yet not formally documented in Nepal.

Chilapata rain-pool frog *(M. chilapata*) was described in 2009 from Mendabari Beat of Chilapata Reserve Forest, Jalpaiguri district, West Bengal, India (Ohler et al. 2009). It is a small dicroglossid frog which has a greyish beige dorsum with a light golden mid-dorsal line and a pointed snout. A tympanic fold is present; the upper lip is golden white; the hind legs have brown bands; and the ventral side is whitish with a golden shine. The 'Fejarvaryan lines' (V-shaped lines on the ventral side) is distinct; the throat is light grey, and the vocal sac is denser grey (Ohler et al. 2009). Our observations corresponded to the original description of *M. chilapata* and differed from all known *Minervarya* species of Nepal. Therefore, we report the first record of Chilapata rain-pool frog from the Pathari-Kanepokhari forest patch, Pathari-Sanishchare Municipality, Morang District, Province-01 and from Barandabhar Biological Corridor, Chitwan National Park, Bagmati Province, Nepal.

On 08 July 2020, at approximately 21:25 h; the first author was conducting the second phase of the herpetofauna survey as part of biodiversity assessment in Pathari-Sanishchare Municipality, Morang District, Nepal. A calling male (Fig. 1) was spotted from the open ground within a mixed forest dominated by Sal (*Shorea robusta*). The trilling call of the male was different from other associated frog species.

On close observation, the whitish vocal sac of the calling male appeared different from other species of the genus *Minervarya* known from Nepal. The nearby habitat was also searched in consecutive days and other calling males and amplecting pairs were also found (Fig. 2). Two males and two females were captured by hand, photographed, preserved, and deposited at the Museum of Biodiversity Conservation Center in Chitwan, Nepal (BCC/HR 61-64). The morphological characters were measured with digital vernier calipers following Ohler et al. (2009), including measurements of EL- eye length; EN- distance from front of eye to nostril; FL- femur length (from vent to knee); FLL- forelimb length (from elbow to base of outer tubercle); FOL- foot length (from base of inner metatarsal tubercle to tip of toe); HAL- hand length (from base of outer palmar tubercle to tip of longest finger); HL- head length (from back of mandible to tip of snout); HW- head width; IN- internasal space; Interorbital distance (IOD)- the distance between the median margins of the

Figure 1. Calling male of Chilapata rain-pool frog (*Minervarya chilapata*) from Morang, Nepal. Photo by Bivek Gautam.

orbits; NS- distance from nostril to tip of snout; SL- distance from front of eye to tip of snout; SVL- snout-vent length; TL- tibia length (Shank length); TYD- greatest tympanum diameter; TYE- distance from tympanum to back of eye; UEW- maximum width of upper eyelid (Table 1).

Call properties were measured using Raven Pro v1.6 (Charif et al. 2010) and the terminology used to describe the vocalization of *M. chilapata* followed Bee et al. (2013a; b). A total of five calls from a single male were analyzed for this study. We analyzed five temporal properties for this species (call duration, call rise time, call fall time, number of pulses per call, and pulse rate) and one spectral property (overall dominant frequency). For visual representations of the call, an oscillogram was prepared using a time frame of 0.5 seconds and a spectrogram was prepared at a similar time frame as the oscillogram.

Our specimens showed morphological characters associated with *M. chilapata* and different from other *Minervarya* species found in Nepal (Table 2). In particular, the anterior parts of the body (head, snout, dorsum, lateral body) were smooth whereas posterior parts of the body showed glandular warts. The dorso-lateral folds were absent, but a light dorso-lateral band was present. The ventral side of the body was smooth and the "Fejarvayan lines" present.

Table 1. Morphometric measurements of four specimens of *Minervarya chilapata* from Morang, Nepal.

Characters	Specimens			
	Female1 BCC/HR-61	Female2 BCC/HR-62	Male1 BCC/HR-63	Male2 BCC/HR-64
EL	2.62	2.49	2.44	2.90
EN	2.33	2.25	1.72	1.90
FL	9.97	9.97	7.91	8.84
FLL	4.55	5.88	3.82	5.01
FOL	12.89	11.72	10.07	11.34
HAL	5.59	5.22	4.03	4.70
HL	8.39	7.78	6.03	7.07
HW	6.70	7.09	5.78	5.93
IN	2.32	2.15	1.84	2.45
IOD	2.00	2.14	1.60	2.08
NS	1.74	1.98	1.27	1.49
SL	4.17	4.08	3.26	3.58
SVL	24.68	25.78	20.59	20.68
TL	12.06	12.18	9.43	10.87
TYD	1.54	1.50	0.84	1.32
TYE	1.56	1.36	0.94	0.96
UEW	1.48	1.64	1.47	1.54

Figure 2. Amplecting pair of Chilapata rain-pool frog (*Minervarya chilapata*). Photo by Bivek Gautam.

Table 2. Morphological differences of *Minervarya chilapata* with other *Minervarya* species in Nepal. The morphological characters of other *Minervarya* species were compared with published keys (Schleich and Kästle 2002; Shah and Tiwari 2004; Khatiwada et al. 2021).

Characters		*M. chilapata*	*M. nepalensis*	*M. pierrei*	*M. syhadrensis*	*M. teraiensis*
SVL (mm)	Male	18–21	28–35	26–31	Up to 32	46
	Female	23–26	Female (36–38) mm	Female (32–48) mm	Up to 40	55
Dorsum		Smooth, greyish beige, light golden middorsal line present or absent	Smooth, grey, four longitudinal folds, white irregular	Smooth, six longitudinal folds, distinct mid dorsal line	Granular, greyish to olive brown, with or without yellowish white line	Smooth, scattered tubercles, white middorsal line present
Venter		Smooth, whitish	Smooth, groin yellowish	Smooth, white	Smooth, white	Smooth, creamy white
Vocal sac		Single vocal sac, whitish grey	Dark vocal sac	Pair of dark vocal sacs	Throat dark black in males	Pair of dark vocal sac with 'W' shaped pattern
Laterals		Fold absent, black band present	Small irregular folds present	Irregular folds present	Irregular folds present	Irregular folds present
Photo		Photo: Bivek Gautam	Photo: Santosh Bhattarai	Photo: Bivek Gautam	Photo: Santosh Bhattarai	Photo: Santosh Bhattarai

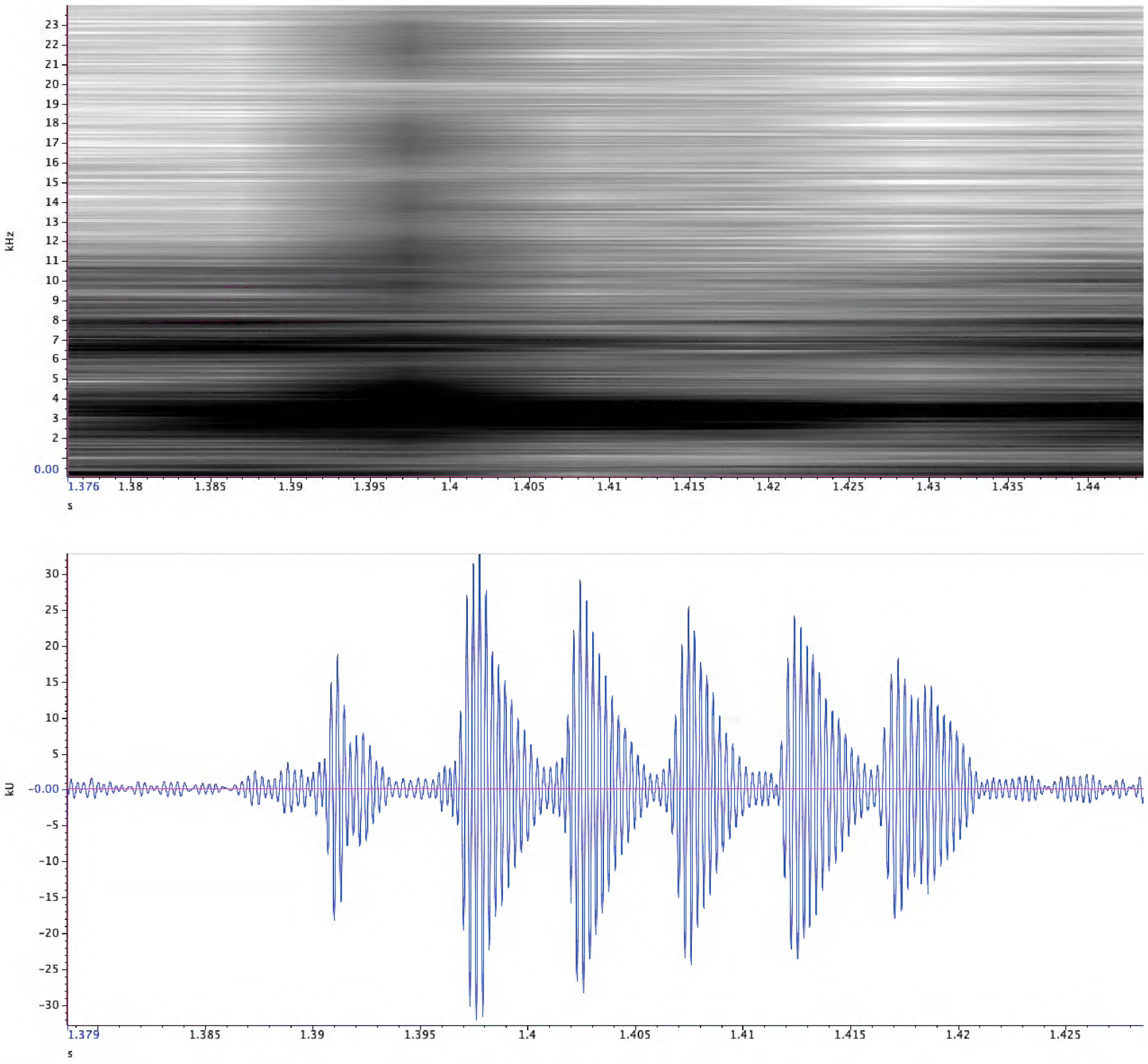

Figure 3. 0.5 s spectrogram (top) and oscillogram (bottom) showing a male call of *Minervarya chilapata* with six pulses.

Minervarya chilapata produced a single type of call and the calls produced had pulsatile temporal structure (Fig. 3) and were generally observed to be organized into longer "call groups" (see Thomas et al. 2014; Garg et al. 2021). Call duration ranged between 29.2 and 36.9 ms (Table 3). The call envelope was characterized by a mean rise time of 7.6 ms and followed by a relatively longer fall time of 25.4 ms, with 6 pulses delivered at a mean rate of 187.5 pulses/second (Table 3). The spectrum was characterized by a single broad peak with a mean dominant frequency of 3.4 kHz.

The measurements of specimens in our study ranked *M. chilapata* as the smallest frog among the *Minervarya* species in Nepal. The individuals we observed in Pathari-Kanepokhari forest, Morang were ca. 182 km west of its type locality from Chilapata Reserve Forest, West Bengal, India (Fig. 4). We took also photographs of similar species in 2015 from Bob Tal, Barandabhar Corridor Forest, Chitwan National Park which remained unidentified at that time. Now, after the records of the Morang population, we confirm the photographic evidence from Bob Tal, Barandabhar corridor forest, Chitwan National Park as *M. chilapata* (Fig. 5). The records of *M. chilapata* from Nepal share the same Himalayan foothills with type locality and is the northern part of the Gangetic plain known as Terai.

Table 3. Call characteristics of a male *Minervarya chilapata* based on the values determined from a sample of 5 calls (n=1). Shown here are the means, standard deviation (SD), Minimum (Min) and Maximum (Max).

	Call Duration (ms)	Call Rise Time (ms)	Call Fall Time (ms)	No of Pulses (n)	Pulse rate (Pulses/s)	Dominant Frequency (KHz)
Mean	33.1	7.6	25.4	6.0	187.5	3.4
SD	3.1	1.9	1.9	0.7	10.1	0.03
Min	29.2	5.6	23.6	5.0	176.7	3.4
Max	36.9	10.7	28.3	7.0	198.0	3.5

The range extension of *M. chilapata* from Chilapata Reserve Forest to Nepal's Morang up to Chitwan has resulted in the extent of occurrence (EOO) on 62,462 km^2.

The Pathari-Kanepokhari forest comes under two municipalities and consists of different Community Forests namely Sundar, Hariyali, Pashupati Community Forest in Pathari-Sanishchare Municipality and Sita chha Dhaare, Mahila Jagriti and Gramin Sudhar community forest in Kanepokhari Rural Municipality. These Community Forests are managed by local communities.

Community forest management in Nepal provides a well-known successful example of participatory resource

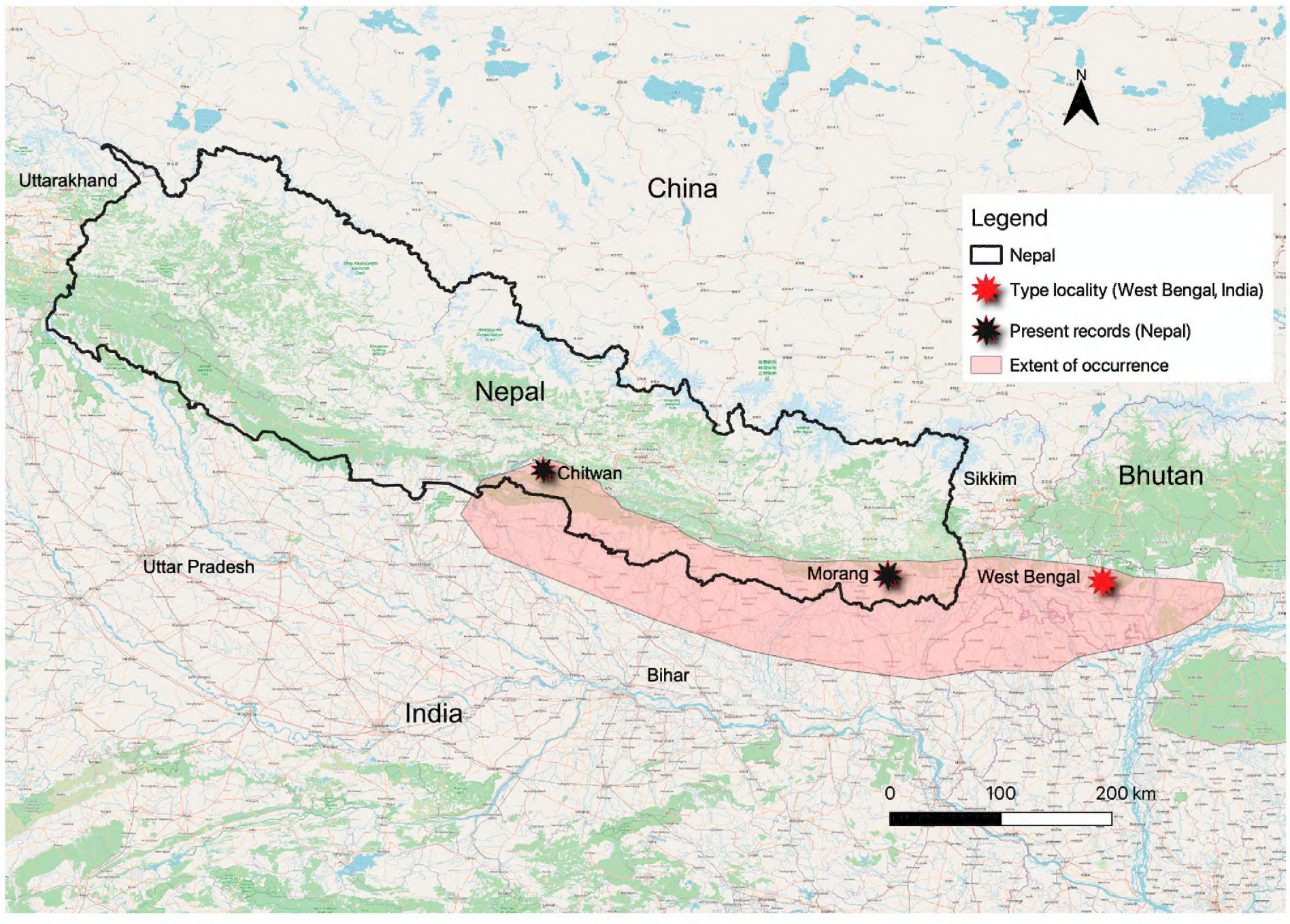

Figure 4. Map showing distribution of *Minervarya chilapata* in Nepal and India.

Figure 5. *Minervarya chilapata* frog from Bob Tal Barandabhar Corridor, Chitwan National Park, Nepal. Photo by Santosh Bhattarai

Figure 6. Habitat of *Minervarya chilapata* from Morang, Nepal. Photo by Bivek Gautam

management, with outcomes including the reversal of deforestation and increased forest regeneration (Shrestha et al. 2010). While community-based wildlife conservation in buffer zone areas of Protected Areas has encouraged the involvement of local communities in wildlife conservation in Nepal (Khatiwada et al. 2020b), the conservation of wildlife, and especially herpetofauna, is negligible (Bhattarai et al. 2020). Since community forests are outside of Nepal's protected area network, they are predominantly managed for resource harvesting (Shrestha et al. 2010). Our observations of *M. chilapata* within the community forests of Pathari-Kanepokari forest suggest that the management of these forests should take biodiversity and the protection of herpetofauna into account. All our observations of *M. chilapata* were from open grassland with rain pools or puddles (Fig. 6). In addition to *M. chilapata*, we also recorded other associated species such as *Microhyla taraiensis*, *Hylarana tytleri*, *Hydrophyllax leptoglossa*, *Humerana humeralis*, and *M. pierrei*. The International Union for Conservation of Nature (IUCN) has listed *M. chilapata* as a Data Deficient species with current population trend unknown. Our records from Nepal provide additional presence data for *M. chilapata* for future assessments. We suggest a detailed inventory of this species in adjacent forests to better understand its ecology and distribution.

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